Validating An Expeditionary Air Squadron Medical Allowance

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ABSTRACT

The aim of this study was to determine the ability of the U.S. Navy Air Expeditionary Squadron (AES) Authorized Medical Allowance List (AMAL) 0960 to meet the medical needs of current AES operations. The study compared the capabilities of AMAL 0960 with two proposed variations, one developed by AES flight surgeons, and the other developed using Naval Health Research Center (NHRC) medical requirements modeling processes. NHRC statisticians collected data on patient presentations seen by AES medical personnel during 20 squadron deployments in support of Operation Enduring Freedom, Operation Iraqi Freedom, and other military operations. This information was used to develop a patient condition occurrence frequency table based on 336 *International Classification of Diseases, 9th Revision*, codes. Computer simulation models were built for each of the three AMAL 0960 versions: (a) the original AMAL currently deployed with squadrons, (b) the flight surgeon-proposed revision, and (c) the NHRC-developed revision. The modeling showed the NHRC line list was the only AMAL version capable of treating the full spectrum of probable patient conditions seen during AES missions with only a moderate increase in weight, cube, and cost.

Keywords: flight medicine, modeling, Authorized Medical Allowance List, naval air forces

Current and future naval air power concepts of operation call for the forward deployment of EA-6B Prowler or EA-18G Growler electronic warfare squadrons and P3 Orion maritime patrol detachments to remote operating bases in support of the North Atlantic Treaty Organization and other operations. In recent years, these units have deployed to Afghanistan, Bahrain, Saudi Arabia, Kuwait, Qatar, Iraq, and the Philippines.

Responsibility for routine medical care rests with the squadron and is supported by the Air Expeditionary Squadron (AES) Authorized Medical Allowance List (AMAL) 0960, where health care provided by a flight surgeon and two non-independent duty aerospace medical technicians. The AMAL is designed to provide a Role I level of care (emergency flight line care and sick call) for 90 days without resupply. The squadron must have advanced medical support and base operating support from other nearby airfield units. Depending on the type of squadron, the population at risk (PAR) is between 100 and 200 naval personnel, with 50 personnel on flight orders. Pain control is limited to oral or injectable nonsteroidal anti-inflammatory drugs.

AMAL 0960 was developed in 2005. A proposed upgrade was created by naval flight surgeons in 2011 and submitted to Commander, Naval Air Forces (CNAF) for type commander review and approval. In 2011, CNAF asked Naval Health Research Center (NHRC) for research assistance in determining the adequacy of AMAL 0960 in meeting the medical needs of AES operations. CNAF also tasked NHRC to compare the current AMAL 0960 medical capabilities with the flight-surgeon-proposed AMAL revision with the goal of establishing an optimal AMAL configuration that met the medical care needs of AES operations while minimizing cost, weight, and cube.

METHODS

The NHRC medical resources modeling process involves several steps. NHRC creates a patient stream based on an appropriate PAR and historic casualty rates. NHRC uses several casualty estimation programs to develop injury and illness frequency distributions, including the Patient Condition Occurrence Frequency (PCOF) tool and the Ground Forces Casualty Projection System. The resulting patient stream can be a mix of combat injuries (including multiple traumas) and/or an array of disease and nonbattle injuries with their associated *International Classification of Diseases, 9th Revision,* (ICD-9) codes. The statistical results are augmented by subject matter expert inputs and verified by subject matter expert review.

The patient stream is then imported into the Expeditionary Medical Knowledge Warehouse (EMedKW) database. EMedKW contains the data structures and content necessary to support the NHRC family of medical modeling and simulation software, including the Estimating Supplies Program, the Joint Medical Planning Tool, the Medical Contingency File (MCF) program, and the ReSupply Validation Program. EMedKW is a service-oriented architecture system designed to protect and organize medical data. The system provides medical analysts with the ability to estimate the requirements to treat a particular patient distribution, while it also tracks inventory to monitor mission readiness.

Within EMedKW, the clinical tasks required to treat each patient condition (i.e., ICD-9 code) are identified and matched with the required equipment and consumable items. In the analysis phase, NHRC reviews the process output, making revisions as needed until an appropriate line list has been developed for the customer's review.

The following example illustrates the programmatic modeling internal to EMedKW (**Fig. 1**). The ICD-9 code 800.0 is selected within a service branch medical treatment facility and functional area. The figure shows a U.S. Navy Forward Resuscitative Care, or Role II, medical

treatment facility. The functional area is “Triage/Pre-Op.” Next, numerous clinical tasks are associated with this treatment, including, for example, “Insert Endotrach Tube.” Equipment and consumable items required to perform this task are then identified.

To begin this study, NHRC conducted a review of the literature and written guidance of official naval air force policy, doctrine, and concepts of operation pertaining to the deployment of electronic warfare squadrons and maritime patrol detachments, as well as medical lessons learned from previous AES deployments. Operational requirements documents for AMAL 0960 were also reviewed. PAR data for Prowler/Growler squadrons and P-3 Orion patrol detachments were provided by CNAF flight surgeons, as were Unit Identification Codes (UICs) for those units.

Using the squadron UICs, pertinent AES patient encounter data were drawn from the Joint Theater Trauma Registry, the Theater Medical Data Store, the Armed Forces Health Longitudinal Technology Application, and the Global Expeditionary Medical System databases, and analyzed by NHRC statisticians for occurrence frequency of illness and injury ICD-9 codes. All patient data used in support of this study were de-identified to ensure privacy.

The UICs produced a database of 2,919 AES patient presentations over 20 separate unit deployments to Afghanistan, Bahrain, Saudi Arabia, Kuwait, Qatar, Iraq, and the Philippines between 2004 and late 2011. All patient presentations were either disease or nonbattle injuries. **Fig. 2** shows a breakdown of AES patient presentations by ICD-9 subgroups.

Using this medical encounter information, NHRC statisticians determined that the average number of patients seen each week by AES flight surgeons was equal to 2.5% of the total PAR per week or about 10% of the PAR per month. For this study, NHRC decided to use

the largest possible PAR for AES squadrons (200) over a 90-day period, resulting in 20 patient presentations per month or 60 presentations for the entire 3-month period.

NHRC statisticians also used these patient data to develop an AES-specific PCOF table of ICD-9 code-based patient condition probabilities. NHRC medical analysts imported these probabilities into a Poisson distribution tool, which was developed by NHRC. The Poisson tool uses the PCOF probabilities to create multiple patient streams. Each patient stream it creates is slightly different from the last, based on the probability of each ICD-9 code to occur. Each patient stream, or "iteration," is then ranked ordered from lowest to highest. Typically, the 75th, 80th, or 85th percentile is chosen as a base patient stream depending on how robust a patient stream is needed for the study. (The degree to which a patient stream is robust affects the amount of consumable supplies that will be used.)

For this study, the Poisson tool produced a base patient stream with a total of 83 patients, 23 more than the estimated 3-month average.

NHRC's EMedKW database contains a list of all clinical tasks performed at Role I treatment facilities. Not all Role I MTFs perform all of these tasks, but rather some subset of the overall list depending on their mission requirements. NHRC asked CNAF flight surgeons to identify which clinical tasks they wanted the AES AMAL to be capable of performing. This resulted in a list of 48 clinical tasks the flight surgeons considered necessary for the AES medical mission.

Construction of the models representing the current and flight surgeon-proposed AES AMALs revealed that neither version had all the supplies required to perform all the tasks identified by the CNAF surgeons. The current version of the AMAL (identified as "0960-current" in the model) did not have equipment or consumables to complete 23 of the identified

tasks. The modified version (identified as “0960-modified” in the model) lacked the resources to complete 19 tasks.

Using the currently deployed AMAL 0960 as its foundation, NHRC developed an AMAL line list (identified as “0960-NHRC” in the model) containing all the supplies and equipment necessary to complete all 48 tasks identified by the flight surgeons. Twenty-three items had to be added to the current AMAL 0960 line list so all of these identified tasks could be accomplished. To maintain Navy standardization, the added items were selected either from the CNAF-modified AES AMAL or another Navy AMAL.

The **Table** shows the clinical tasks each AMAL version was capable of completing.

The completed models were incorporated into EMedKW along with the AES-specific patient stream developed by NHRC statisticians. Using these data, a scenario was created in the NHRC MCF program, a stochastic modeling program used for developing medical supply lists. The MCF randomly produced a patient stream based on the probability of each patient condition (ICD-9) in the base casualty stream. It then produced a list of medical supplies needed to treat the patient stream. One hundred varying patient streams and supply lists were created in this fashion. The quantity of each supply item produced by each patient stream was then rank ordered from lowest quantity to highest. The 80th percentile was used to produce the supply lists for all three versions of the AES AMAL.

RESULTS

The differences in line item quantities between the current and the CNAF-modified AMAL 0960, and the quantities produced for those same AMAL versions by the MCF process, were not dramatic. This was because the MCF output was rounded up to full units of issue (UIs)—as used in both CNAF versions of the AMAL—so a comparison could be made. A

greater difference is seen when only partial UIs (i.e., partial packages) are used, bringing the AMAL supply quantities in line with the actual need as shown by the model. Whether full or partial UIs are used, only the supply lists developed by NHRC can complete all 48 clinical tasks identified by CNAF flight surgeons as being necessary to complete the AES medical mission.

DISCUSSION

CNAF adopted the NHRC-recommended optimized partial-UI line list as the official AES AMAL. Since conclusion of this study, CNAF has tasked NHRC to perform similar optimization studies for the entire family of 24 AMALs used by medical personnel aboard nuclear aircraft carriers.

CONCLUSIONS

The NHRC process for modeling medical resource requirements showed that neither of the CNAF versions of AMAL 0960 could adequately complete the AES medical mission. However, adding 23 consumable and equipment items, identified using this modeling process, to the currently deployed AMAL 0960 gave it the capability to fulfill its mission. If, where applicable, the AMAL is built using partial UIs, significant savings in weight, cube, and cost can be achieved while maintaining mission readiness.

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TABLE IDENTIFIED CLINICAL TASKS CAPABLE OF BEING PERFORMED WITH THREE VERSIONS OF AMAL 0960.

Task no.	Task Description	0960 Current	0960 Modified	0960 NHRC
001	Triage	Yes	Yes	Yes
002	Assessment and evaluation of patient status	Yes	Yes	Yes
005	Remove and collect belongings, valuables and equipment	Yes	Yes	Yes
006	Establish adequate airway (oro/naso pharyngeal only)	No	Yes	Yes
007	Emergency cricothyroidotomy	No	No	Yes
010	Neurological assessment	Yes	Yes	Yes
011	Stabilize spine (collar/spine board)	No	Yes	Yes
019	Emergency control of hemorrhage	No	No	Yes
024	Vital signs	Yes	Yes	Yes
049	Start/change IV infusion site	Yes	No	Yes
050	Administer IV fluid	Yes	No	Yes
070	Bowel sounds assess	Yes	Yes	Yes
079	Catheterization Foley	No	No	Yes
082	Measure/record intake/output	No	No	Yes
085	Wound irrigation	Yes	Yes	Yes
086	Clean and dress wound	Yes	Yes	Yes
090	Compresses (soaks)	No	No	Yes
091	Apply ice/hot packs	Yes	Yes	Yes
093	Extremity elevation	Yes	Yes	Yes
096	Apply sling/swath	No	No	Yes
098	Apply splint/immobilize injury	No	Yes	Yes
103	Circulation check	Yes	Yes	Yes
108	Minor surgical procedure (debride/suture/incision)	No	No	Yes
121	Eye irrigation	Yes	Yes	Yes
123	Eye care (dressings/eye patch)	No	No	Yes
124	Ear care irrigation	Yes	Yes	Yes
125	Sponge/hyperthermia treatment	No	No	Yes

Task no.	Task Description	0960 Current	0960 Modified	0960 NHRC
125	Sponge/hyperthermia treatment	No	No	Yes
126	Seizure care/precautions	No	No	Yes
127	Patient restraint (gauze, ties)	No	No	Yes
142	Order and document appropriate meds/treatment	Yes	Yes	Yes
145	Administer appropriate medication	Yes	Yes	Yes
204	Assign patient safety special watch	Yes	Yes	Yes
247	Place respiratory isolation mask	No	No	Yes
278	Arrange for patient evacuation	Yes	Yes	Yes
279	Arrange and document return to duty	Yes	Yes	Yes
359	Induce local anesthesia	No	Yes	Yes
639	Pregnancy determination	Yes	Yes	Yes
748	Assemble material/clean up	No	Yes	Yes
A12	Occlude sucking chest wound	No	No	Yes
A2	Remove casualty from danger	Yes	Yes	Yes
A6	Apply tourniquet	No	Yes	Yes
Z014	Intubation	No	No	Yes
Z027	Cardio arrest resuscitation	Yes	Yes	Yes
Z039	Perform ventilation with bag valve mask	No	No	Yes
ZZ02	Stain & examine eyes (fluorescent/UV lamp)	Yes	Yes	Yes
ZZ03	Needle thoracostomy	No	No	Yes
ZZ27	General treatment area setup	Yes	Yes	Yes

Fig. 1. An example of the EMedKW programmatic modeling process.

Fig. 2. AES sick call presentations, over 20 separate unit deployments, by ICD-9 subgroups.

Fig. 1

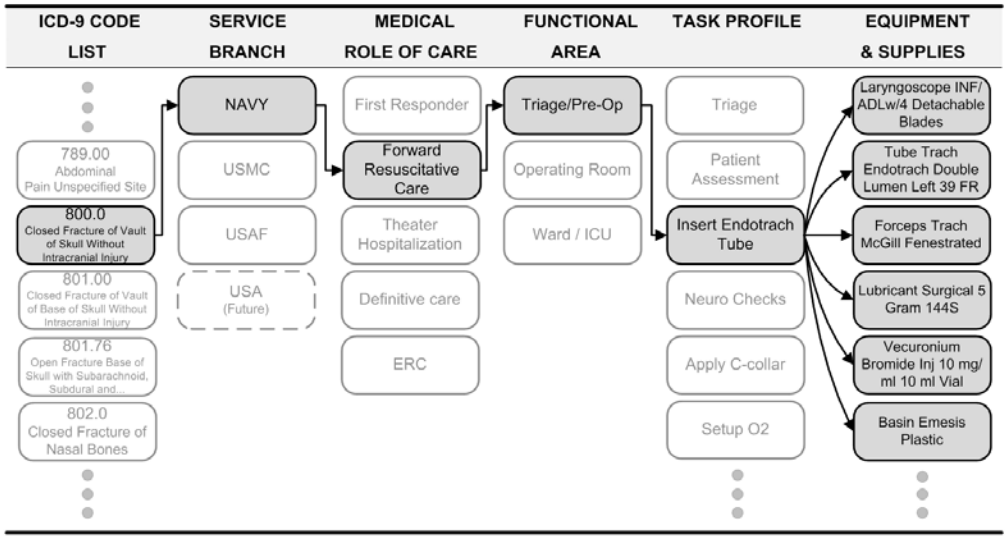
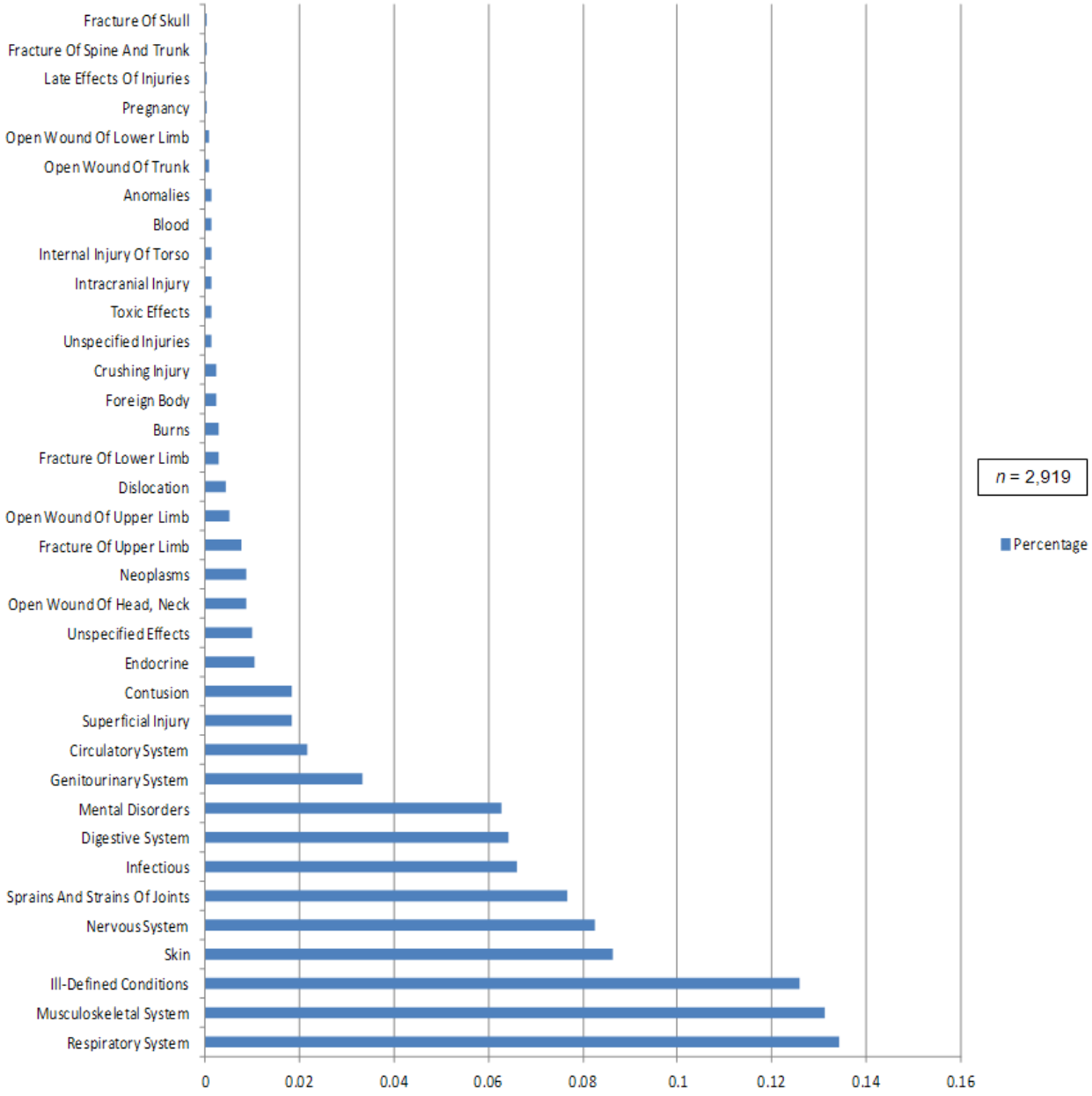

ICD-9 CODE LIST
SERVICE BRANCH
MEDICAL ROLE OF CARE
FUNCTIONAL AREA
TASK PROFILE
EQUIPMENT & SUPPLIES
789.00 Abdominal Pain Unspecified Site
800.0 Closed Fracture of Vault of Skull Without Intracranial Injury
801.00 Closed Fracture of Vault of Base of Skull Without Intracranial Injury
801.76 Open Fracture Base of Skull with Subarachnoid, Subdural and...
802.0 Closed Fracture of Nasal Bones
NAVY
USMC
USAF
USA (Future)
First Responder
Forward Resuscitative Care
Theater Hospitalization
Definitive care
ERC
Triage/Pre-Op
Operating Room
Ward / ICU
Triage
Patient Assessment
Insert Endotrach Tube
Neuro Checks
Apply C-collar
Setup O2
Laryngoscope INF/ ADLw/4 Detachable Blades
Tube Trach Endotrach Double Lumen Left 39 FR
Forceps Trach McGill Fenestrated
Lubricant Surgical 5 Gram 144S
Vecuronium Bromide Inj 10 mg/ ml 10 ml Vial
Basin Emesis Plastic

Fig. 2


Fracture Of Skull
Fracture Of Spine And Trunk
Late Effects Of Injuries
Pregnancy
Open Wound Of Lower Limb
Open Wound Of Trunk
Anomalies
Blood
Internal Injury Of Torso
Intracranial Injury
Toxic Effects
Unspecified Injuries
Crushing Injury
Foreign Body
Burns
Fracture Of Lower Limb
Dislocation
Open Wound Of Upper Limb
Fracture Of Upper Limb
Neoplasms
Open Wound Of Head, Neck
Unspecified Effects
Endocrine
Contusion
Superficial Injury
Circulatory System
Genitourinary System
Mental Disorders
Digestive System
Infectious
Sprains And Strains Of Joints
Nervous System
Skin
Ill-Defined Conditions
Musculoskeletal System
Respiratory System
0
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0.16
n = 2,919
Percentage

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14. ABSTRACT (maximum 200 words)

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14. **SUBJECT TERMS**
flight medicine, modeling, AMAL, Naval Air Forces, Air Expeditionary Squadron

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